

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

Claims 1-17 (cancelled)

Claim 18 (new): A liquid fuel direct supply fuel cell system, comprising:
a generator having a plurality of cells connected serially or in parallel, the cell in which an anode and a cathode are oppositely installed through a protonic conductive polymer electrolyte membrane, a liquid fuel is supplied from a fuel inlet to the anode and is exhausted from a fuel outlet, and an oxidizing agent gas is supplied from a gas inlet to the cathode and is exhausted from a gas outlet;

a fuel tank for storing a liquid fuel to be supplied to the anode;

a high concentration fuel tank for storing a high concentration fuel used for regulating a concentration of the liquid fuel in the fuel tank;

a water tank for storing water produced by a cell reaction of the generator,

a sensor integrally installed with the generator and comprising a temperature detector and a monitor cell having a protonic conductive polymer electrolyte membrane, an anode and a cathode installed on both faces of the membrane, a fuel inlet for supplying the liquid fuel to the anode, a fuel outlet for exhausting the liquid fuel from the anode, a gas inlet for supplying an oxidizing agent gas to the cathode, and a gas outlet for exhausting the oxidizing agent gas from the cathode; the sensor detecting the concentration of the liquid fuel by a temperature compensated electromotive force, produced by compensating an electromotive force of the monitor cell by an output signal of the temperature detector,

the fuel inlet and the fuel outlet of the sensor being communicated with the fuel inlet and the fuel outlet of the generator and the oxidizing agent gas inlet and the oxidizing agent gas outlet of the sensor being communicated with the oxidizing agent gas inlet and the oxidizing agent gas outlet of the generator, and

a controller for operating at least one of a control of a supply of the high concentration fuel from the high concentration fuel tank to the fuel tank, a control of a supply of water from the water tank to the fuel tank, and a control of a supply of the liquid fuel from the fuel tank to the generator, on the basis of the output signal from the sensor.

Claim 19 (new): A liquid fuel direct supply fuel cell system according to claim 18, wherein:

a second temperature detector is installed in at least one place around the fuel inlet of the generator or around the fuel outlet of the generator, for detecting a temperature around the place, to measure heat generated by the liquid fuel, permeated through the electrolyte membrane of the monitor cell and oxidized by the cathode, on the basis of a difference between the signal from the temperature detector of the sensor and the signal from the second temperature detector.

Claim 20 (new): A liquid fuel direct supply fuel cell system according to claim 18, wherein:

the oxidizing agent is air,

the sensor has at least one pair of separators, in which a via hole for air inlet and a via hole for air outlet and a via hole for fuel inlet and a via hole for fuel outlet are made, and has the protonic conductive polymer electrolyte membrane and the anode and the cathode between the separators,

each cell of the generator has separators, in which a via hole for air inlet and a via hole for air outlet and a via hole for fuel inlet and a via hole for fuel outlet are made, and

the sensor is arranged in a side for the fuel inlet to the generator.

Claim 21 (new): A liquid fuel direct supply fuel cell system according to claim 20, wherein:

the generator has an anode side endplate and an anode side terminal plate in the one end of a plurality of cells and a cathode side endplate and a cathode side terminal plate in the other end; and

the sensor is installed between the endplate and the terminal plate of the anode side.

Claim 22 (new): A liquid fuel direct supply fuel cell system according to claim 8, wherein:

the temperature detector is mounted on an opposite plane of the protonic conductive electrolyte membrane of the separator of the anode side of the sensor.

Claim 23 (new): A liquid fuel direct supply fuel cell system according to claim 18, wherein:

a fuel concentration decline is detected from an increase in the temperature compensated electromotive force, between the anode and the cathode, and a fuel concentration rise is detected from a decrease in the temperature compensated electromotive force.

Claim 24 (new): A liquid fuel direct supply fuel cell system according to claim 23, further including:

a means for determining a slope of a change in the temperature compensated electromotive force at a start of operation.

Claim 25 (new): A liquid fuel direct supply fuel cell system according to claim 24, further including:

a means for getting the temperature of the generator and for subjecting the fuel concentration to an open loop control, separately from the temperature compensated electromotive force, until the generator reaches a predetermined temperature, at the start of operation.

Claim 26 (new): A method for the liquid fuel direct supply fuel cell system, comprising:

a generator having a plurality of cells connected serially or in parallel, the cell in which an anode and a cathode are oppositely installed through a protonic conductive polymer electrolyte membrane, a liquid fuel is supplied from a fuel inlet to the anode and is exhausted from a fuel outlet, and an oxidizing agent gas is supplied from a gas inlet to the cathode and is exhausted from a gas outlet;

a fuel tank for storing a liquid fuel to be supplied to the anode;
a high concentration fuel tank for storing a high concentration fuel used for regulating a concentration of the liquid fuel in the fuel tank;
a water tank for storing water produced by a cell reaction of the generator,
providing a sensor integrally installed with the generator and comprising a temperature detector and a monitor cell having a protonic conductive polymer electrolyte membrane, an anode and a cathode installed on both faces of the membrane, a fuel inlet for supplying the liquid fuel to the anode, a fuel outlet for exhausting the liquid fuel from the anode, a gas inlet for supplying an oxidizing agent gas to the cathode, and a gas outlet for exhausting the oxidizing agent gas from the cathode; the sensor detecting the concentration of the liquid fuel by a temperature compensated electromotive force, produced by compensating an electromotive force of the monitor cell by an output signal of the temperature detector,
making the fuel inlet and the fuel outlet of the sensor communicated with the fuel inlet and the fuel outlet of the generator respectively and making the oxidizing agent gas inlet and the oxidizing agent gas outlet of the sensor communicated with the oxidizing agent gas inlet and the oxidizing agent gas outlet of the generator respectively, and
providing a controller for operating at least one of a control of a supply of the high concentration fuel from the high concentration fuel tank to the fuel tank, a control of a supply of water from the water tank to the fuel tank, and a control of a supply of the liquid fuel from the fuel tank to the generator, on the basis of the output signal from the sensor.

Claim 27 (new): An operation control device of the liquid fuel direct supply fuel cell system, comprising:

a generator having a plurality of cells connected serially or in parallel, the cell in which an anode and a cathode are oppositely installed through a protonic conductive polymer electrolyte membrane, a liquid fuel is supplied from a fuel inlet to the anode and is exhausted from a fuel outlet, and an oxidizing agent gas is supplied from a gas inlet to the cathode and is exhausted from a gas outlet;
a fuel tank for storing a liquid fuel to be supplied to the anode;
a high concentration fuel tank for storing a high concentration fuel used for regulating a concentration of the liquid fuel in the fuel tank;

a water tank for storing water produced by a cell reaction of the generator,
a sensor integrally installed with the generator and comprising a temperature detector and a monitor cell having a protonic conductive polymer electrolyte membrane, an anode and a cathode installed on both faces of the membrane, a fuel inlet for supplying the liquid fuel to the anode, a fuel outlet for exhausting the liquid fuel from the anode, a gas inlet for supplying an oxidizing agent gas to the cathode, and a gas outlet for exhausting the oxidizing agent gas from the cathode; the sensor detecting the concentration of the liquid fuel by a temperature compensated electromotive force, produced by compensating an electromotive force of the monitor cell by an output signal of the temperature detector,
the fuel inlet and the fuel outlet of the sensor being communicated with the fuel inlet and the fuel outlet of the generator and the oxidizing agent gas inlet and the oxidizing agent gas outlet of the sensor being communicated with the oxidizing agent gas inlet and the oxidizing agent gas outlet of the generator, and
a controller for operating at least one of a control of a supply of the high concentration fuel from the high concentration fuel tank to the fuel tank, a control of a supply of water from the water tank to the fuel tank, and a control of a supply of the liquid fuel from the fuel tank to the generator, on the basis of the output signal from the sensor.

Claim 28 (new): A liquid fuel direct supply fuel cell system, comprising:
a generator having a plurality of cells connected serially or in parallel, the cell in which an anode and a cathode are oppositely installed through a protonic conductive polymer electrolyte membrane, a liquid fuel is supplied from a fuel inlet to the anode and is exhausted from a fuel outlet, and an oxidizing agent gas is supplied from a gas inlet to the cathode and is exhausted from a gas outlet;
a fuel tank for storing a liquid fuel to be supplied to the anode;
a high concentration fuel tank for storing a high concentration fuel used for regulating a concentration of the liquid fuel in the fuel tank;
a water tank for storing water produced by a cell reaction of the generator,
a sensor provided integrally with the generator, for measuring a liquid fuel concentration, the sensor comprising a liquid permeable membrane for permeating the liquid fuel, an oxidation electrode having a catalyst for oxidizing the liquid fuel permeated through

the liquid permeable membrane, a means for supplying the oxidizing agent gas to the oxidation electrode to oxidize the liquid fuel permeated through the membrane by the oxidation electrode, and a temperature detector for detecting a temperature rise caused by oxidization on the oxidation electrode so as to measure the liquid fuel concentration by an output signal from the temperature detector, and

a controller for operating at least one of a control of a supply of the high concentration fuel from the high concentration fuel tank to the fuel tank, a control of a supply of water from the water tank to the fuel tank, and a control of a supply of the liquid fuel from the fuel tank to the generator, on the basis of the output signal from the temperature detector of the sensor.

Claim 29 (new): A liquid fuel direct supply fuel cell system according to claim 28, wherein:

the sensor has a fuel inlet and a fuel outlet and an oxidizing agent gas inlet and an oxidizing agent gas outlet, and

the fuel inlet and the fuel outlet of the sensor are communicated with the fuel inlet and the fuel outlet of the generator, respectively, and the oxidizing agent gas inlet and the oxidizing agent gas outlet of the sensor are communicated with the oxidizing agent gas inlet and the oxidizing agent gas outlet of the generator, respectively.